ALGEBRA.

433. Proposed by B. J. BROWN, student at Drury College.

Prove that, if all the quantities, a, b, etc., are real, then all the roots of the equations

$$\begin{vmatrix} a-x & h \\ h & b-x \end{vmatrix} = 0, \qquad \begin{vmatrix} a-x & h & g \\ h & b-x & f \\ g & f & c-x \end{vmatrix} = 0$$

are real; and generalize the proposition.

434. Proposed by S. A. JOFFE, New York City.

Express the "difference of zero," $\Delta^n 0^{n+1}$, in the form, $C_1(n+2)! - C_2(n+1)!$, where C_1 and C_2 are numerical coefficients independent of n.

435. Proposed by C. N. SCHMALL, New York City.

Show that $(e-1) - \frac{1}{2}(e-1)^2 + \frac{1}{3}(e-1)^3 - \cdots = 1$, where e is the Naperian base of logarithms.

GEOMETRY.

463. Proposed by B. J. BROWN, student at Drury College.

If μ and ν are the parameters of the two confocal conics through any point on the ellipsoid

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1,$$

show that $\mu + \nu + a^2 + c^2 = 0$, along a central circular section.

464. Proposed by FRANK R. MORRIS, Glendale, Calif.

The sum of the hypotenuse and one side of a right triangle is 100 feet. A point on the hypotenuse is 10 feet from each of the sides. Find the length of the hypotenuse correct to the third decimal place.

465. Proposed by ROGER A. JOHNSON, Western Reserve University.

Let C be a fixed circle, A a point outside it. Let AT and AT' be the tangents from A to the circle, touching the latter at T and T'. Let two secants be drawn through A, cutting the circle at P, Q and R, S respectively. Let PR and QS meet at X, PS and QR meet at Y. Prove by elementary methods that for all positions of the secants, X and Y lie on the line TT'.

CALCULUS.

383. Proposed by WILLIAM CULLUM, Albion, Mich.

Find the area of the curved surface of a right cone whose base is the asteroid, $x^{2/3} + y^{2/3} = a^{2/3}$, and whose altitude is h.

From Townsend and Goodenough's *First Course in Calculus*, p. 288, Ex. 11.

Note.—Among other methods, find the required area by means of the formula

$$\int \sqrt{1 + \left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2}\, dxdy.$$ EDITORS.

384. Proposed by JOSEPH B. REYNOLDS, Lehigh University.

In what time will a sum of money double itself at 6 per cent. interest per annum if compounded at indefinitely short intervals?

385. Proposed by H. B. PHILLIPS, Massachusetts Institute of Technology.

If $f(x)$ is continuous between a and x, show that

$$\operatorname{Lim}_{n=\infty} \frac{n!}{(x-a)^n} \int_a^x \cdots \int_a^x f(x)dx^n = f(a).$$